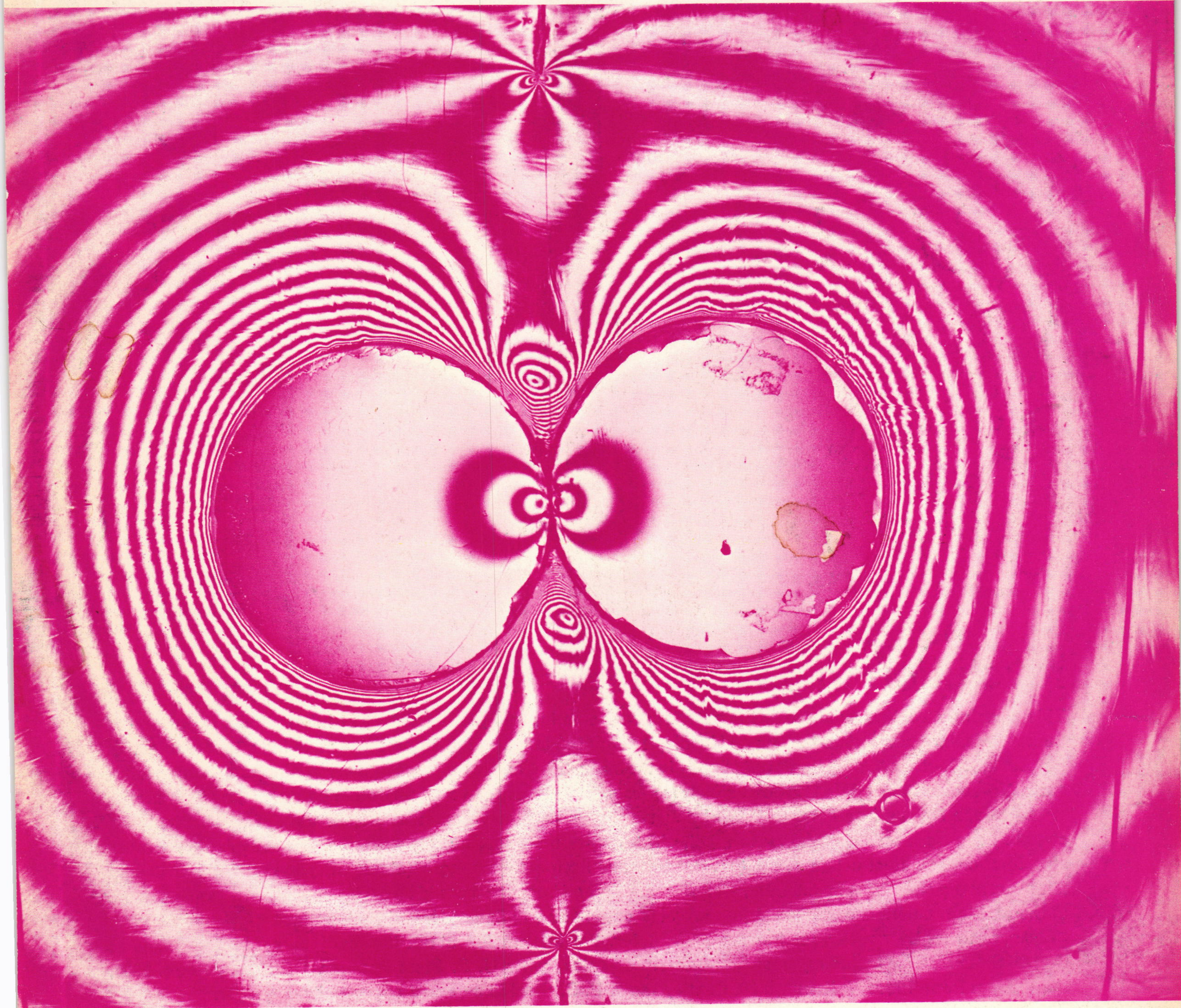
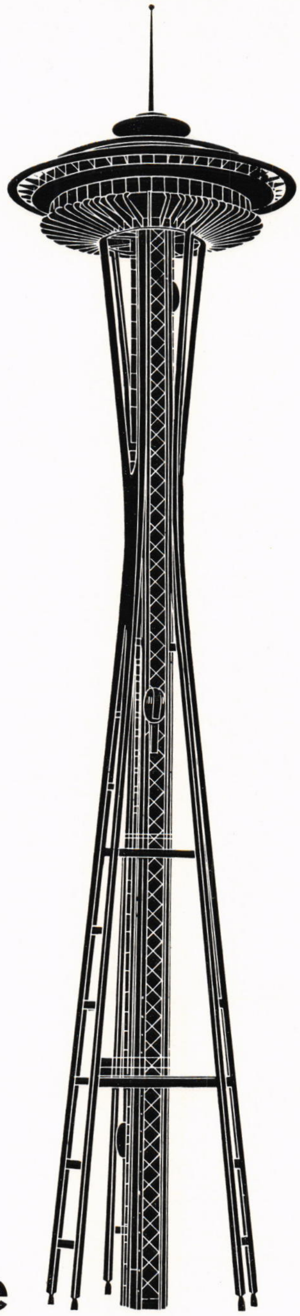
the Mechelecciv
VOL. 20 APRIL 1962 NO. 5

THE GEORGE WASHINGTON UNIVERSITY ~ SCHOOL OF ENGINEERING ~



THE GEORGE WASHINGTON UNIVERSITY

APRIL 1962



revolution in space

This amazing structure symbolizes the outer space theme for this year's Century 21 International Exposition in Seattle, Washington. Called the Space Needle, it soars 600 feet into the air on three steel legs, tapers to a slim waist at the 373-ft. mark, then flares out slightly to the 500-ft. level, and is crowned by a mezzanine, observation deck, and a 260-seat restaurant that *revolves* slowly (one complete revolution an hour) while patrons enjoy their meals.

The Space Needle is a combination of sheer audacity and imagination with 3,500 tons of steel. Steel was chosen because it would be faster to erect, stronger per unit area, quickly available. A relatively new type of structural carbon steel called A36 was used because its greater strength (about 10%) permits higher design stresses, at the same time maintaining factors of safety, and because it could be easily welded. This is an example of the exciting materials and challenging projects engineers will find at United States Steel.

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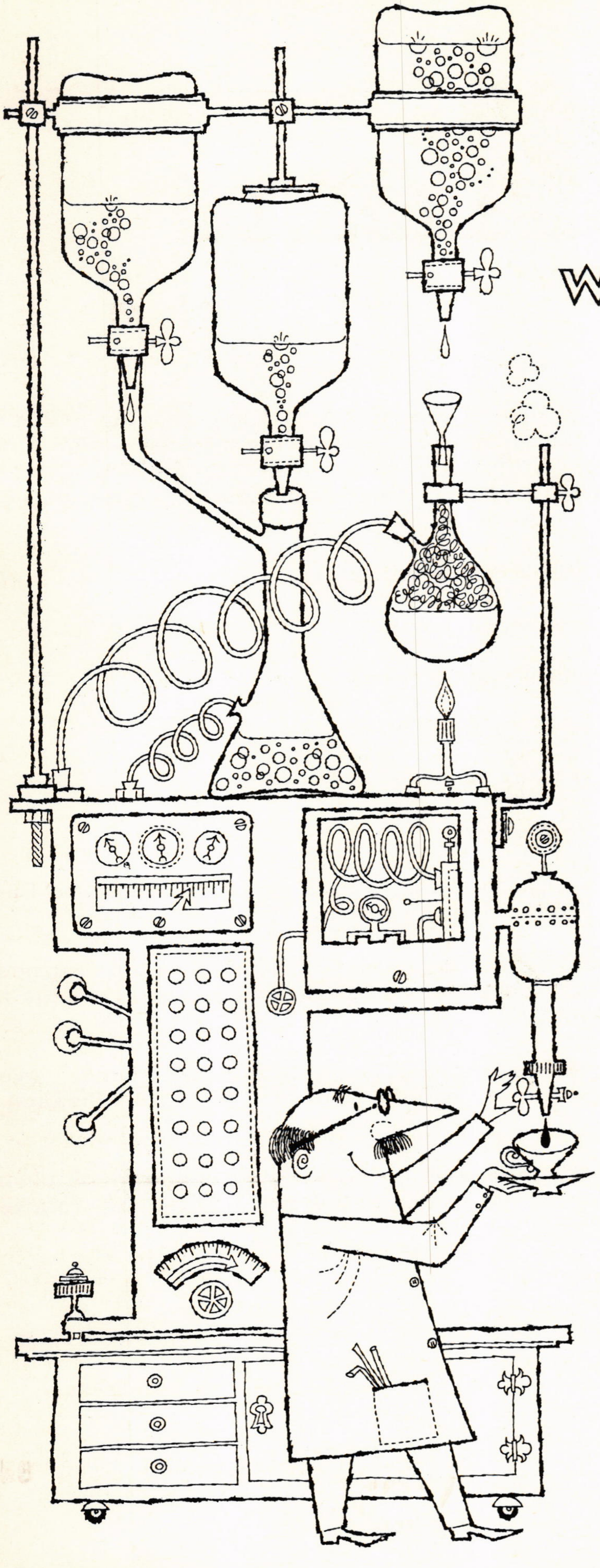

what's pure research?

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EDITORIAL

To the student:

For several years, it has been the privilege of several engineering organizations of honoring those students in the School of Engineering who have shown outstanding leadership and/or scholarship. Usually, these awards are given out at the Engineers' Ball. This year, however, a special Engineers' Awards Night is being planned.

Among the awards given out will be the following:

Outstanding freshman

Outstanding sophomore

Deacon Ames Award

Council Keys

Mecheleciv Keys

These and other awards are given by Sigma Tau, Theta Tau, AIEE-IRE, the Engineers' Council, Sigma Epsilon, and the Mecheleciv Staff.

Needless to say, this will be one of the "high-light" functions of the Engineering School. It is also pointless to say that <u>all</u> of the engineering organizations are backing this event one hundred percent.

This means that every phase of engineering is participating: hence, every student of engineering should do the same, in behalf of his particular branch of interest.

The Mecheleciv Board of Editors, therefore, would like to go down on record as a whole-hearted supporter, urging every student studying engineering to attend the Engineers' Awards Night.

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the Mecheleciv

VOL. 20 APRIL 1962 NO. 5

ARTICLES

PHOTOELASTIC ANALYSIS OF STRAIN
by Tom Nielsen 4

TWO-MILE ELECTRON ACCELERATOR
by Dillon Scofield 6

FEATURES

MECH MISS 8-9

CAMPUS NEWS 10

TENSION BUSTERS 12

This month's cover shows a photoelastic fringe pattern produced by the shrinkage of an epoxy resin around two glass disks in contact. (Note the fourth-order fringe in the glass near the joint of contact.)

Published at the George Washington University by direction of the Engineers' Council. Published six times during the school year in October, November, December, March, April, and May. Entered as second class matter March 6, 1951, at the Post Office at Washington, D. C., under the act of March 3, 1879. Address communications to Mecheleciv Magazine, Davis-Hodgkins House, George Washington University, Washington 6, D. C. or telephone FEderal 8-0250, Extension 528.

Subscription Price: Two Dollars

CHANGE OF ADDRESS: Send your new address at least 30 days before the date of the issue with which it is to take effect.

PHOTOELASTIC ANALYSIS OF STRAIN

by Tom Nielsen

Artificial double refraction, the production of double refraction effects by stress applied to an isotropic transparent material, was discovered by Sir David Brewester in 1816. He found that a plate of glass under a simple compressive stress acquired the properties of a negative uniaxial crystal, a crystal which has only one optic axis. Under simple tension the plate of glass acquired the properties of a positive uniaxial crystal. In each case the line of stress corresponded to the optic axis in the analogous crystal.

Kerr, Filon and Pockels were some of the investigators of the above mentioned phenomenon. From their investigations the following conclusions were obtained:

(1) If an isotropic transparent solid such as glass is subjected to a simple normal stress P, it behaves like a uniaxial crystal, the direction of P corresponding to the optic axis of the crystal.

(2) If light passes through a plate, perpendicular to the plane of the plate and perpendicular to the stress P of the stressed plate, the light is polarized into two waves whose vibrations are respectively parallel and normal to P.

(3) The retardation produced in each wave is proportional to the stress, but the constants of proportionality are different. It is also proportional to the thickness of the plate traversed by the light.

From these three conclusions quantitative results of the retardation can be derived. If light traverses a plate of thickness t in a direction perpendicular to a simple tension P in the plate and C_1 and C_2 are the constants for the two oppositely polarized waves, then the retardations

λ_1 and λ_2 in Angstroms are:

$$\lambda_1 = C_1 Pt \tag{1}$$

$$\lambda_2 = C_2 Pt \tag{2}$$

$$\lambda_1 - \lambda_2 = (C_1 - C_2)\, Pt = CPt \tag{3}$$

where $C = C_1 + C_2$ is the stress-optional coefficient.

If the material is subjected to two normal stresses, P and Q, in perpendicular directions, the total retardations are the sums of the retardations produced by the separate stresses.

$$\lambda_1 = (C_1 P + C_2 Q)\, t \tag{4}$$

$$\lambda_2 = (C_2 P + C_1 Q)\, t \tag{5}$$

the relative retardation λ is

$$\lambda_1 - \lambda_2 = (C_1 - C_2)\,(P-Q)\, t \tag{6}$$

$$\lambda = C\,(P-Q)\, t \tag{7}$$

In 1841 Neumann carried out the first investigation into the theory of artificial double refraction in a solid subjected to any system of forces. The earlier investigations were with only simple tension or compression members. Neumann attributed the effect to the strain in the body and obtained his results in terms of strain. In 1852 Clerk Maxwell used stress instead of strain and came up with the same results. The laws formulated by these two men are as follows:

(1) At any point in a stressed transparent solid the axes of polarization of light passing through the solid are parallel to the directions of the principal stresses in the plane of the wave-front at that point.

(2) The difference of the velocities of the oppositely polarized rays at the point is proportional to the difference of these two principal stresses, and is independent of stresses perpendicular to the plane of the wave front.

Thus the direction of polarization will be the direction of the principal axes of the stress-conic in the plane of the wave front.

In order for one to be able to interpret the relative retardation produced in the light passing through a finite thickness of a stressed body in terms of stresses in the body, two conditions are necessary.

(1) The direction of the principal stresses in the plane of the wave front must be the same at all points on the path of the ray. If this is not the case, the light will continually re-polarize in different directions as it passes through the body. The effects of the retardation in different layers could not be summed to give the total effect.

(2) The magnitudes of the principal stresses in the plane of the wave front must not undergo large changes from point to point of the path of any ray.

If the magnitudes of the principal stresses do suffer large changes, then the mean retardation observed will not give even an approximate idea of the value at any point of the path.

The relative retardation produced by the stresses in the plate is measured by interference and one must start with a beam of plane polarized light incident normally on the plate.

This beam will be split into two perpendiculary polarized waves on entering the plate. As the waves pass through the plate they will have unequal retardations proportional to the stress in the plate. After leaving the plate the waves must be re-polarized into one plane for them to exhibit interference. The initial polarization and the final re-polarization are done by two polarizing elements. This is shown graphically in Figure 1 and can be described analytically as follows:

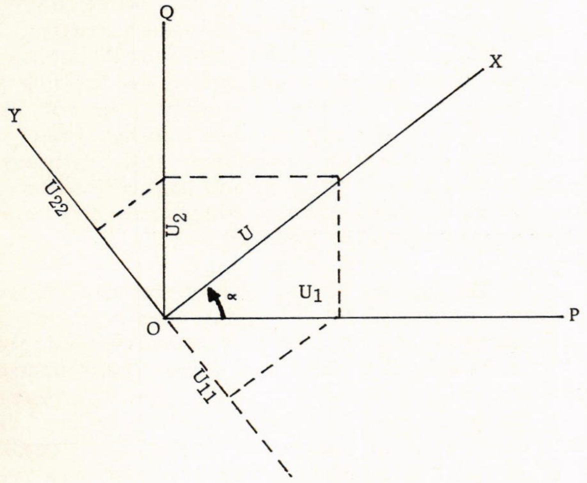


Figure No. 1

Let OX represent the direction of vibration of a wave after it has passed through the first polarizing element, OX being the direction of the principal axis of the polarizing element. Let the displacements U in this vibration at time to be given by

$$U = a \sin {}^{2\pi}/_{\lambda}(V_o t - x) \quad (8)$$

Consider a point in the stressed plate where the principal stresses P and Q in the plate are in the direction OP and OQ respectively. The original pollarized wave U then be broken up into two components U_1 and U_2 in the direction of OP and OQ.

These components U_1 and U_2 are:

$$U_1 - U \cos\alpha \quad (9)$$

$$U_2 = U \sin\alpha \quad (10)$$

where α is the angle XOP.

Substituting the value of U into equations (9) and (10)

$$U_1 - a \cos\alpha \sin \frac{2\pi}{\lambda}(V_o t - x) \quad (11)$$

$$U_2 - a \sin\alpha \sin \frac{2\pi}{\lambda}(V_o t - x) \quad (12)$$

As the waves pass through the stressed plate, U_1 is retarded an amount r. Therefore the waves that emerge from the plate are

$$U_1' = a \cos\alpha \sin {}^{2\pi}/_{\lambda}(V_o t - x - r) \quad (13)$$

$$U_2' = a \sin\alpha \sin {}^{2\pi}/_{\lambda}(V_o t - x) \quad (14)$$

If the second polarizing element has its principal axis perpendicular to the first polarizing element and in the direction OY, it will pass waves only in the direction OY. Therefore the waves U_1 and U_2 must each be resolved into two components. One component parallel to OY and one perpendicular to OY. The final transmitted wave will consist of the algebraic sum of the components parallel to OY which are U_{21} and U_{22} where

$$U_{11} = U_1' \sin\alpha \quad (15)$$

$$U_{22} = U_2' \cos\alpha \quad (16)$$

$$\text{and } U_{oy} = U_{22} - U_{11} = U_2' \cos\alpha - U_1' \sin\alpha \quad (17)$$

substituting equations (13) and (14) into (17)

$$U_{oy} = a \sin\alpha \cos\alpha \left\{\sin \frac{2\pi}{\lambda}(V_o t - x) - \sin 2\,{}^{\pi}/_{\lambda}(V_o t - x - r)\right\} \quad (18)$$

or

$$V_{oy} = a \sin Z\alpha \sin \frac{\pi r}{\lambda} \cos \frac{2\pi}{\lambda}(V_o t - x - r) \quad (19)$$

This is a vibration whose amplitude is

$$a \sin 2\alpha \sin \frac{\pi r}{\lambda}$$

The intensity will be zero if either $\sin 2\alpha$ or $\sin \frac{\pi r}{\lambda}$ is zero, and a maximum when $\sin 2\alpha = \pi$ or $\alpha = \frac{\pi}{4}$.

The first condition $\sin 2\alpha = \pi$ or $\sin 2\alpha = n\pi$ is the condition where the principal stresses P and Q are parallel to the polarizer and analyzer respectively, which are the two polarizing elements. Under this condition no light will be transmitted on to a screen. Therefore certain black regions will appear when the models image is viewed on a screen. These black regions show the loci of points in the model where the direction of the principal stresses are parallel to the axes of the polarizer and analyzer. These loci are called isoclinic lines which indicate the directions of the principal stresses at all points of the model. Generally the directions of the principal stresses will vary throughout the model. If the polarizer and analyzer are rotated simultaneously still keeping their axis perpendicular to each other the isoclinics will move to points on the model where the principal stresses are parallel to the new directions of the axes of the polarizer and analyzer.

Therefore a set of isoclinics will be obtained and are usually labeled the n degree isoclinics as the polarizer and analyzer are rotated n degrees.

For the second condition of zero intensity where $\frac{\pi r}{\lambda} = n\pi$ or $r = n\lambda$ which is the relative retardation, a set of fringes are obtained which are called isochromatics. They are proportional to the load placed on the model and dependent on

--Continued on Page 10

TWO-MILE ELECTRON ACCELERATOR

by Dillon F. Scofield

Particle accelerators are the basic hardware of high energy physics. In name they range from cyclotrons, bevatrons, synchrotrons, cyclosynchrotrons, Van de Graaff generators, and linear accelerators to terrestrial and interstellar magnetic fields (in cosmic ray research). Though there are some 56 human engineered particle accelerators in the United States and some 135 in the world, only 10 of these are of linear design.

One such accelerator is now under construction at Stanford University. Its two mile length and related laboratories will be completed in six years, at a cost of 114 million dollars.

Consisting of two construction and operation stages, the accelerator will accelerate electrons to energies upward of 20 Bev (20 billion electron volts) in its initial stage. This is 50 or more times greater than that available from conventional circular accelerators. Later the Stanford "Linac", as linear accelerator is abbreviated, will provide electrons of energies up to 45 Bev for research. It will be built at Palo Alto, California, under the auspices of the AEC and Stanford University.

Excluding single pulse Van de Graaff and linear accelerators, particle accelerating systems are of circular design. All operate by subjecting particles to the influence of an electric field bounded by a powerful electromagnetic field. This magnetic field, produced by bulky electromagnets, forces the particles to revolve in circular or spiral orbits. The particles are accelerated as they cross the dee gap, often traveling 130 miles before targeting. The particles in larger accelerators reach energies of 30 Bev.

The chief difference between the circular machines and linear accelerators rests in the fact that in the former, particles receive many small "pushes" while constrained by electromagnetics to revolve many times around a stationary core. Particles linearly accelerated pass but once through a straight accelerating chamber (hence "linear"). In this case, particles pass individual accelerating points only once. Because they are linear, linear systems do not require field containing magnets, which in the larger circular machines comprise the majority of the accelerator bulk. In fact, one such circular machine, the new CERN 30 Bev accelerator is apparently all magnet for its 2000 foot circumference.

Originally it was thought that linear accelerators, because of their greater simplicity and lack of apparent energy ceiling would be used universally in particle acceleration. However, several important improvements in circular machine design extended their usefulness to cover most lower energy particle acceleration. Despite improvements, at higher energy levels of 10 Bev or more, circular machines have an inherent limitation in electron acceleration. At these velocities and above, so much energy is radiated (in the form of x-rays), that further acceleration is prohibitively costly. In contrast, no such radiation loss occurs during linear acceleration, since the electrons are confined to straight trajectories. Theoretically, linear accelerators can accelerate electrons to immense energies unobtainable by circular methods.

The design of linear accelerators involves two basic approaches. One, the standing electromagnetic wave design, uses intermittent acceleration. Acceleration occurs at the gaps between tubes which shield the particles from the reverse half cycle of the electromagnetic wave. The traveling wave type, uses the continuous acceleration of an electromagnetic wave down a wave guide. The phase velocity, greater than c (speed of light), in a smooth wave guide, is limited to values below c by disks with center holes. This type, due to energy and economy requirements, is most suited to electron acceleration. While the standing wave design is better suited to heavy ion acceleration, the traveling wave design accelerator has proven itself to be more economical and practical in actual tests with smaller linacs, hence the Stanford Linac will be of the traveling wave design.

The linear accelerator concept is not altogether new: Wideröe in 1928, accelerated potassium ions by a linear system and in 1931 Sloan and Lawrence conducted a series of experiments where they produced a small beam 10^{-7} Å of mercury ions at 1.26 Mev by a 30 Mc/s, 40 KV r.f. voltage accelerator.

Despite this early progress, it was not until after World War II, when microwave technology was sufficiently advanced, that the Klystron tubes, used in accelerating electrons in existing linacs, were developed. The most important post-war linac constructed, is now in operation (since 1954) at Stanford. Called the Mark III, it was built by W. W. Hansen of Stanford. Linear systems of the Hansen design consist of an electricly conducting tube divided into a number of subsections by means of copper disks with center holes placed at increasing intervals, all of which form a wave guide where the phase velocity is allowed to progressively increase while keeping in step with the accelerated particles, as the wave length increases and the frequency remains constant. Electrons entering on the accelerating phase are thus constantly accelerated in phase with the traveling wave as they continue down the cham-

--Continued on Page 11

MECH MISS

Vicki Thornton

Vicki Thornton, a very attractive philosophy major, is Sigma Tau's choice for Mech Miss this month. Vicki is a junior transfer student from the University of Arizona where she attended for two years. The summer following her first two years at Arizona, she took part in the Experiment in International Living by spending most of the summer in Switzerland. The summer ended with two weeks in Syria and Lebanon and a decision to forsake Western palms and climate for Eastern ivy and scholarship.

Her outside interests include books, travel, tennis, and music. Her musical interests include Italian Operas, Tchaikovsky and folk music. Vicki hopes eventually to teach philosophy at the college level at which she will certainly be successful.

CAMPUS NEWS

THETA TAU

During March, Theta Tau held its Spring Initiation Banquet and Ball at the Evans Farm Inn. The new brothers are Robert Alvarez, Jerry Edwards, Marshal Levitan, and Donald Miller. Jerry Edwards received the award for constructing the best replica of the Theta Tau emblem, a required pledge duty of all new members. Other presentations included a gavel to Fred Hood for his contributions as Regent of the fraternity, and a token of appreciation to Herb Wilkinson for his performances at this and past dinner dances. Among those enjoying the festivities were Mrs. Arthur Nielson and Mrs. Moffette Tharpe, each of whom had recently given birth to little girls, Christina Ann and Kimberly Ann, respectively.

Regent Fred Hood represented Gamma Beta Chapter at the Regional Conclave of Theta Tau. This year, it was held at the campus of the University of Alabama in Tuscaloosa.

SIGMA TAU

At the last meeting of Sigma Tau, plans were made for the Spring Banquet and Ball. The date is now set for April 14, 1962, at Tom Sarris Steak House. Elections were held for officers for the year 1962-1963:

President	-- Marvin Fox
Vice President	-- Donald Miller
Secretary	-- Faith Smith
Treasurer	-- Paul Treynor

ASCE

At the March 7 meeting of the ASCE, Mr. T. Richie Edmonston gave a talk on professional ethics. Also, plans were made for the ASCE Regional Conference to be held on April 14, 1962. Busses will be chartered and the group will go to Dulles International Airport where they will have speakers in the morning, and then they will tour the installation in the afternoon.

ASME

At the ASME meeting of March 7, the paper contest was held and prizes awarded. Four very good papers were given:

Joe Sanford, first place -- Dynamic Calibration of Photoelastic Materials

Douglas Jones -- Impure Pneumatic Computers

Arthur Macurdy -- Hydraulic Vibration Isolation for Marine Propeller Shafts

Jerry Edwards -- Theory of Wear

It was decided that Joe Sanford would represent the chapter in the regional paper contest at Lehigh University. The meeting was then adjourned for the refreshments and discussion period.

AIEE-IRE

At their meeting of April 4, 1962, the AIEE-IRE Student Branch elected the officers for the year 1962-1963. They are as follows:

Chairman	-- Eliot Cohen
Vice Chairman	-- Judith Popowsky
Branch Secretary	-- Deane Parker
Treasurer	-- Harvey Flatt
IRE-AIEE Sec.	-- Philip Kaplan
IRE Rep. to E.C.	-- Donald Miller
AIEE Rept. to E.C.	-- Jerry Steffel

Following the meeting, Mr. Ian Hay of Electronic Associates, Inc., gave a speech on analog computers, including in his discussion the basic differences between analog and digital computers, and the fundamental operations performed by analog computers.

PHOTOELASTIC ANALYSIS OF STRAIN—Continued from Page 5

the type of light used. With momochromatic light, the light will be completely extinguished at all points where the stress difference is zero. At other points the light will be partially or completely transmitted since changes in the stress difference are continuous. Thus the effect of the relative retardation will be an appearance in the image of the model of dark lines or fringes. Each of these fringes is a locus of points at which the relative retardation is a certain integral number of wave lengths which are the isochromatic lines of fringes.

All of the theory of photoelasticity is a great step in experimental stress analysis. One can actually see where the stress concentrations are in a particular model. It can be used in many fields such as machine design, structural design, aircraft design and many others where designers are working to the ultimate limit of a particular material. Also theories and hypothesis derived by theories of elasticity, plasticity and vibrations can also be proved experimentally. Experimental stress analysis such as photoelasticity enables aircraft designers to make an appropriate design and they can design a particular area for larger stress thereby possibly reducing the size of the member in other areas.

This decreases the dead weight of the structure and means more pay load that the aircraft or missile can carry. These are problems that arise that cannot be solved analytically and must be solved by some experimental means. Experimental stress analysis and in particular photoelasticity is a tremendous tool in helping to solve structural problems for the Civil, Mechanical and Aeronautical Engineer.

REFERENCES:

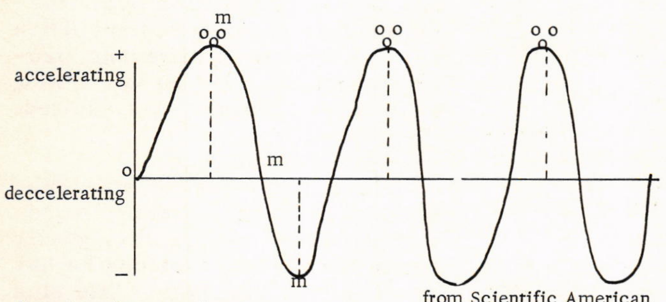
1. Photoelasticity Principles and Methods by H. T. Jessup and F. C. Harris, Dover Publications 1960.

2. Photoelasticity Volume I by Max Mark Frocht, John Wiley & Sons, 1941.

ber. It was due to the successes in the Mark III that led to the proposal of a two mile linear accelerator.

The new two mile accelerator will consist of two parallel tunnels burried in 35 feet of earth. One tunnel will house the Klystron tubes and operation equipment, access gallery, and auxiliary equipment. The other, separated by several feet of earth from the first, will house the evacuated accelerator tube. The Klystrons will provide a vhf radio wave which serves as the accelerating field. Klystron input "stations," vhf input waveguides will be located at approximately 40 foot intervals over the 10,000 foot length. The electrons will be boiled off a filament and given a preliminary focus and acceleration before entering the tube proper.

The Klystrons will produce a regularly varying electromagnetic field. The field, in schematic representation, a sine curve, has a point of peak acceleration relative to the particles at full amplitude above the axis. A peak deceleration occurs below the axis at full amplitude. No acceleration occurs on the axis. To gain maximum energy, particles must "remain" at the positive peak of the curve. Metaphorically, the particles are accelerated much as are the surfriders riding wave crests toward shore.

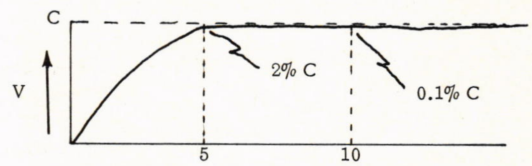


from Scientific American Nov. 1961, p. 53.

In smooth wave guides, the phase velocity, λf, is greater than c and thus cannot transmit energy, just as surfriders cannot "board" a wave which is travelling too fast. For this reason the phase velocity is slowed to less than c in a nonuniform waveguide by the insertion of the previously mentioned center-holed disks.

The apparently difficult task of keeping the particles in step with the wave is solved naturally by a phenomenon labeled "phase stability". This phenomenon of use in bevatrons and synchrotrons obviates the necessity of extreme ultra fine adjustment of the waveguide. To indicate the nature of phase stability suppose that for some arbitrary reason a particle gained too much energy through say, an imperfection in the wave guide or input Klystron. The resultant increase in velocity would impel the particle to a less energetic portion of the field so that in the next accelerating phase the particle would receive less energy. The field, as it were, catches up with it. Due to many such manifestations of the phenomenon, the particle experiences a damped oscillation about the stable case corresponding to a greater probability level. The phase stability phenomenon affects all particles in a likewise manner resulting in the "bunching" of the particles together as they travel down the guide. Net acceleration of the electromagnetic field is produced by increasing the phase velocity by successively lengthening the space between guides while maintaining field strength by the Klystron tubes.

The initial acceleration is occasioned by no great expenditure of energy. The electron mass of 1/1837 amu is so small that it can be readily accelerated to 0.5 c even by the injector gun. And with only 2 Mev acceleration, electrons have reached to within 2% of c. At 5 Mev, the relativistic mass is not too disportionately more compared with the rest mass of 0.51 Mev. But at 20 Bev (0.9999999997 c), the mass is roughly 40,000 times the rest mass. As indicated by the accompanying sketch, this mass increase is quite step. At high velocities most of the energy "goes" into the mass of electrons.

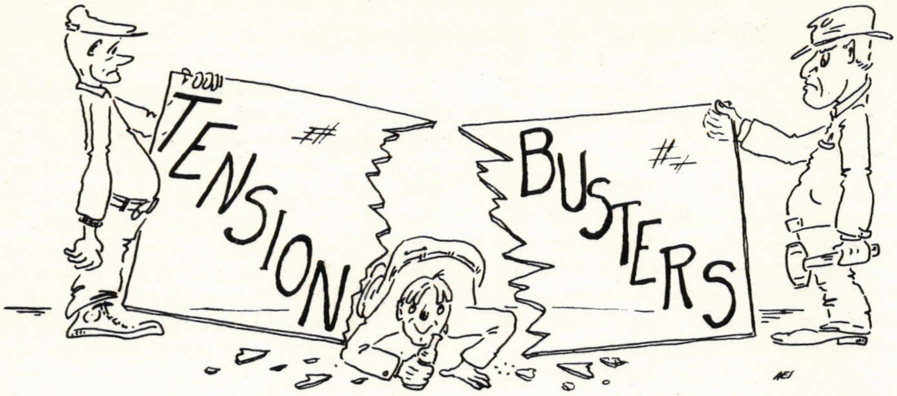


from Accelerators, p. 83.

Though accelerating electrons to c only assymtotically, the Stanford linac Stage I will produce electrons at velocities within one billionth of the speed of light by using 240 Klystrons. Stage II by quadrupling the number of Klystrons will accelerate electrons to within but trillionths of c.

Unfortunately, due to the great load these Klystrons and associated equipment are subject to, the accelerator will have a pulsed cycle, with pulses lasting no more than a few μ sec. In addition, replacement rates of the tubes will be about three per day. However, it is hoped that cycle rates from 1c-400c/sec will compensate for the intermittent production.

Each Klystron tube will have an input of 25 million watts in 25 μ sec or one to two Mev per foot in stage one and 4.5 Mev per foot in stage two. The accelerator beam current for Stage I will be 30 μ amps at 20 Bev and 60 μ amps at 40 Bev. Both stages will be operant in the range down to one Bev. Compared with another large accelerator, the 30 Bev proton synchrotron at Brookhaven National Laboratory, rated at beam current 0.01 amp, the Stanford accelerator will be, indeed worthy of the investment of capital and science required for her building. The beam current of the Stanford accelerator upon its completion will be the largest in the world. The beam energy will be second only to one. Together, these two factors will provide nuclear physics with its most powerful electron probe of the atomic nucleus.



Faculty adviser: "Let's not have any more jokes about sex, drinking, and profanity."

Editor: "O.K., I'm tired of putting out this magazine anyhow."

Counselor: "How do you like this room as a whole?"

Freshman: "As a hole it is fine; as a room, not so good."

A little boy taken to the ballet for the first time watched curiously as the dancers cavorted about on their toes. "Mummy," he whispered loudly, "Why don't they just get taller girls?"

In a college biology test a young coed defined "inbreeding" as breeding in the same stock; for example, one Holstein cow with another Holstein cow. The professor's comment: "A no-ble conception."

A bosomy young pianist in a New York night club attracted much attention from the world of music with her skill at swinging the classics. Pianist Arthur Rubinstein went to see her one evening and was much impressed. "I knew you'd like her boogie woogie," said a friend, "but a great pianist like yourself - well, I didn't imagine you'd be impressed with her Bach." "It isn't her Bach," exclaimed Rubinstein, "It's her front!"

TV director to actors: "Put more feeling into it; it isn't for namby-pambies, it's for bloodthirsty children."

As a junior-high school teacher distributed the first report cards of the year, she noticed that one blond teenager was scowling. "What's the matter? Aren't you satisfied with your marks?" she asked.

"I certainly am not," said the girl. "You gave me an F in Sex and I didn't even know I was taking it!"

Service station: A place where you fill the car and drain the family.

Motorist: "Aren't you the fellow who sold me this car two weeks ago?"

Salesman: "Yes, sir."

Motorist: "Well, tell me about it again. I get so discouraged."

In Idaho State Journal: Pocatello Mattress Factory plays role in city's growth.

One day in the Mayo Clinic an affluent and obnoxious newcomer spied a white-haired doctor in the lobby. He strode up officiously and said, "Tell me, my good man, are you the head doctor here?"

Dr. Will, elder of the two famous Mayo Brothers, bowed courteously: "No, kind sir, it must be my good brother you are seeking. I am the belly doctor."

Some years ago an announcer asked Billy Southworth, then with the St. Louis Cards, whether he had shaved with a Gillette razor that morning. Southworth's startling reply was: "You know bloody well I did."

Girl graduate: "Four years of College! And whom has it got me?"

"I thought you were going to your lodge meeting?"

"It was postponed. The wife of the Grand Exalted Invincible Supreme Potentate wouldn't let him out tonight."

Weeping wife to husband: "For weeks I've been telling you not to buy me anything for my birthday -- and still you forgot to get me something!"

America: the country where people in all walks of life prefer to ride.

We'd had no bites in an entire evening of fishing. As darkness fell and we pulled toward shore we passed a couple in another rowboat.

"Did you have any luck?" we called.

"No," said the young man gloomily.

"What kind of bait were you using?"

For a moment the young man was silent. Then he said, "I wasn't fishing."

In a joke that has wriggled through the Iron Curtain, an escaped Russian, newly arrived in Briton, watched newsreels, comedy skits, and drama over television with great boredom. Then he switched to a different program and his eyes lit up. "Now I feel at home," he exulted. "Puppets!"

Dizzy Dean has been a huge success as a television broadcaster of baseball games, partly because of the innovations he has made in our language. "He slud into third," was the first much-publicized departure. Later he varied "slud" with "slood" and then one afternoon came up with. "The trouble with them boys is they ain't got enough spart." Pressed for an explanation of this, he obliged: "Spart is pretty much the same as fight or pep or gumption. Like the Spart of St. Louis, that plane Lindberg flowed to Europe in."

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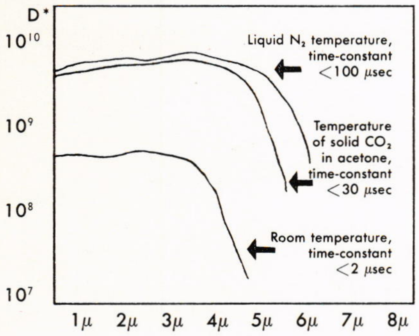
Kodak beyond the snapshot...

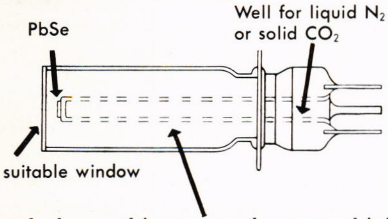
(random notes)

Cool, well-behaved PbSe



See what an improvement can be effected in D*, the normalized detectivity of a lead selenide photoconductive surface, by cooling it.

Therefore in catering to the infrared detector trade we put lead selenide into a little Dewar like this



and draw this space down to high vacuum for cooling efficiency.

But PbSe detectors are reputed to go quickly erratic in high vacuum.

Aha ! We have learned how to lick that.

We expect no congratulations. Just orders.

Could you use a pamphlet on Kodak Ektron detectors? Free from our Apparatus and Optical Division. Might eventually lead to an order. We are patient.

Honest physical labor

Ranking a bunch of films for c-r tube photography is useful work, and it makes the time pass pleasantly between breakfast and supper. Here is what we find:

RELATIVE SPEED

to a 525-line raster, two interlaced fields lasting 1/30 sec over-all, measured at a net density of unity (Transit time of the electron beam past a given point of the phosphor $= 5 \times 10^{-8}$ sec)

Normal development: 4 minutes in Kodak developer D-19 at 68°F.

Phosphor	P11	P4	P15	P16	P24
FILM Kodak Photoflure, Blue Sensitive	2400	180	60	200	83
Kodak Cineflure Kodak Photoflure, Green Sensitive Kodak Linagraph Ortho	1800	500	250	130	240
Kodak Royal Ortho (sheet)	1000	250	130	80	130
Kodak Linagraph Pan Kodak Tri-X Negative	900	320	120	82	120
Kodak Linagraph Shellburst	500	180	60	48	73
Eastman High Speed Positive	360	51	25	45	28
Kodak Royal-X Pan Recording	320	150	65	23	47
Eastman Fine Grain Sound Recording	123	17	5.2	41	4
Eastman Television Recording	*100	11	5.2	7.5	5.2
Eastman Fine Grain Release Positive	35	4	2	6	2
Kodalith Ortho, Type 3	32	5	8	5	8
Kodak High Contrast Copy	20	12	6	4	5

*Arbitrary basis of scale.

Why they rank this way even provides something to think about.

Patterns in blood

Electrophoresis is a means for separating ionic components of a mixture by virtue of their differing mobilities in an electric field. The man who first worked it out wound up with a Nobel Prize for his pains. (We never had the pleasure of an employment application from him.) Subsequently other highly creative types—biochemists mostly—invented ways of doing electrophoresis in wet paper, starch blocks, and other media.

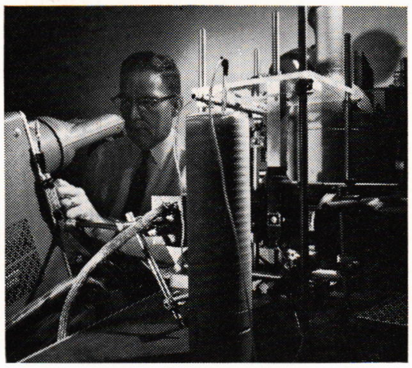
Recently two such chaps at The Mount Sinai Hospital in New York used polyacrylamide gels of two different pore sizes in combination. This speeded it up and permitted separation of blood serum proteins into many more components. It results in a visual pattern that represents an individual's body chemistry at a given moment.

We found out about this so-called disc electrophoresis by paying attention to what people tell us. Savants are always asking about Eastman Organic Chemicals that they hope we can make for them. Sometimes we find there will be no objection and some prospect of benefit to all parties if we will act as a broadcaster of technical information thus picked up.

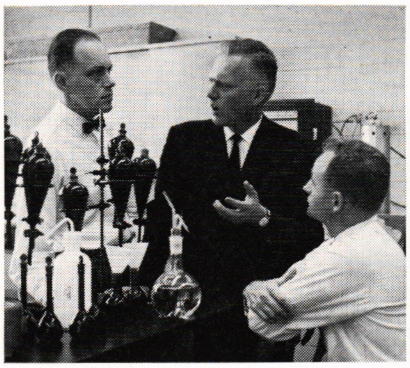
This is happening right now with disc electrophoresis, which uses Eastman Organic Chemicals and about which we are offering far and wide a 69-page disquisition by the two New Yorkers.

In the name of corporate self-interest, much good dope gets cheaply spread.

SOLID-STATE MERCHANDISE PRODUCTION NEEDS GOOD PEOPLE



THE PHYSICS OF PHOTOGRAPHY NEEDS GOOD PEOPLE



VIGOROUS INFORMATION DIFFUSION NEEDS GOOD PEOPLE

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One of a series*

Interview with General Electric's
Charles F. Savage
Consultant—Engineering Professional Relations

How Professional Societies Help Develop Young Engineers

Q. Mr. Savage, should young engineers join professional engineering societies?

A. By all means. Once engineers have graduated from college they are immediately "on the outside looking in," so to speak, of a new social circle to which they must earn their right to belong. Joining a professional or technical society represents a good entree.

Q. How do these societies help young engineers?

A. The members of these societies —mature, knowledgeable men— have an obligation to instruct those who follow after them. Engineers and scientists—as professional people—are custodians of a specialized body or fund of knowledge to which they have three definite responsibilities. The first is to *generate* new knowledge and add to this total fund. The second is to *utilize* this fund of knowledge in service to society. The third is to *teach* this knowledge to others, including young engineers.

Q. Specifically, what benefits accrue from belonging to these groups?

A. There are many. For the young engineer, affiliation serves the practical purpose of exposing his work to appraisal by other scientists and engineers. Most important, however, technical societies enable young engineers to learn of work crucial to their own. These organizations are a prime source of ideas — meeting colleagues and talking with them, reading reports, attending meetings and lectures. And, for the young engineer, recognition of his accomplishments by associates and organizations generally heads the list of his aspirations. He derives satisfaction from knowing that he has been identified in his field.

Q. What contribution is the young engineer expected to make as an active member of technical and professional societies?

A. First of all, he should become active in helping promote the objectives of a society by preparing and presenting timely, well-conceived technical papers. He should also become active in organizational administration. This is self-development at work, for such efforts can enhance the personal stature and reputation of the individual. And, I might add that professional development is a continuous process, starting prior to entering college and progressing beyond retirement. Professional aspirations may change but learning covers a person's entire life span. And, of course, there are dues to be paid. The amount is graduated in terms of professional stature gained and should always be considered as a personal investment in his future.

Q. How do you go about joining professional groups?

A. While still in school, join student chapters of societies right on campus. Once an engineer is out working in industry, he should contact local chapters of technical and professional societies, or find out about them from fellow engineers.

Q. Does General Electric encourage participation in technical and professional societies?

A. It certainly does. General Electric progress is built upon creative ideas and innovations. The Company goes to great lengths to establish a climate and incentive to yield these results. One way to get ideas is to encourage employees to join professional societies. Why? Because General Electric shares in recognition accorded any of its individual employees, as well as the common pool of knowledge that these engineers build up. It can't help but profit by encouraging such association, which sparks and stimulates contributions.

Right now, sizeable numbers of General Electric employees, at all levels in the Company, belong to engineering societies, hold responsible offices, serve on working committees and handle important assignments. Many are recognized for their outstanding contributions by honor and medal awards.

These general observations emphasize that General Electric does encourage participation. In indication of the importance of this view, the Company usually defrays a portion of the expense accrued by the men involved in supporting the activities of these various organizations. Remember, our goal is to see every man advance to the full limit of his capabilities. Encouraging him to join Professional Societies is one way to help him do so.

Mr. Savage has copies of the booklet "Your First 5 Years" published by the Engineers' Council for Professional Development which you may have for the asking. Simply write to Mr. C. F. Savage, Section 959-12, General Electric Co., Schenectady 5, N. Y.

***LOOK FOR** other interviews discussing: Salary • Why Companies have Training Programs • How to Get the Job You Want.

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